Appendix B

I/I Ronald Pilot Project Report

Description:

This appendix contains a summary report prepared by Ronald Wastewater District's consultant to document the experiences of the Ronald I/I Pilot Project.

Reference Chapters:

All chapters

Author:

CHS Engineers, Inc.

Project Report

Basin RON002 I/I Removal Pilot Project
Ronald Wastewater District

Prepared by CHS Engineers

This report summarizes the activities, findings and recommendations for the subject inflow and infiltration (I/I) removal pilot project. This serves as the project closeout report and follows the project plan used for the five quarterly project monitoring reports. The project was divided into six elements and each element was further subdivided to varying levels of detail as appropriate for planning and monitoring the corresponding work. The six project elements are: project management, predesign, public relations, design, bidding/contracting, and construction. In this report, the activities, observations, or findings for this project and recommendations for future similar projects are discussed for each project element. This report focuses on those activities specifically related to I/I removal projects, with emphasis on the challenges associated with working on side sewers and private property, with only minimal attention to more common aspects of public works design and construction projects. The I/I removal resulting from this work is not addressed in this report but will be addressed in a separate report to be prepared by King County.

The project's objective was to determine the effectiveness of replacing side sewers as a means to reduce I/I. The project area included approximately 290 single family residential properties in a sanitary sewer basin in the southwestern portion of Ronald Wastewater District (herein referred to as RWD or District). Figure 1 is a map of the project area.

The project was one of ten pilot projects selected by King County Department of Natural Resources Wastewater Treatment Division (herein referred to as KCWTD, KC or the County) as part of their Inflow/Infiltration control program, an element of the County's Regional Wastewater Services Plan (RWSP).

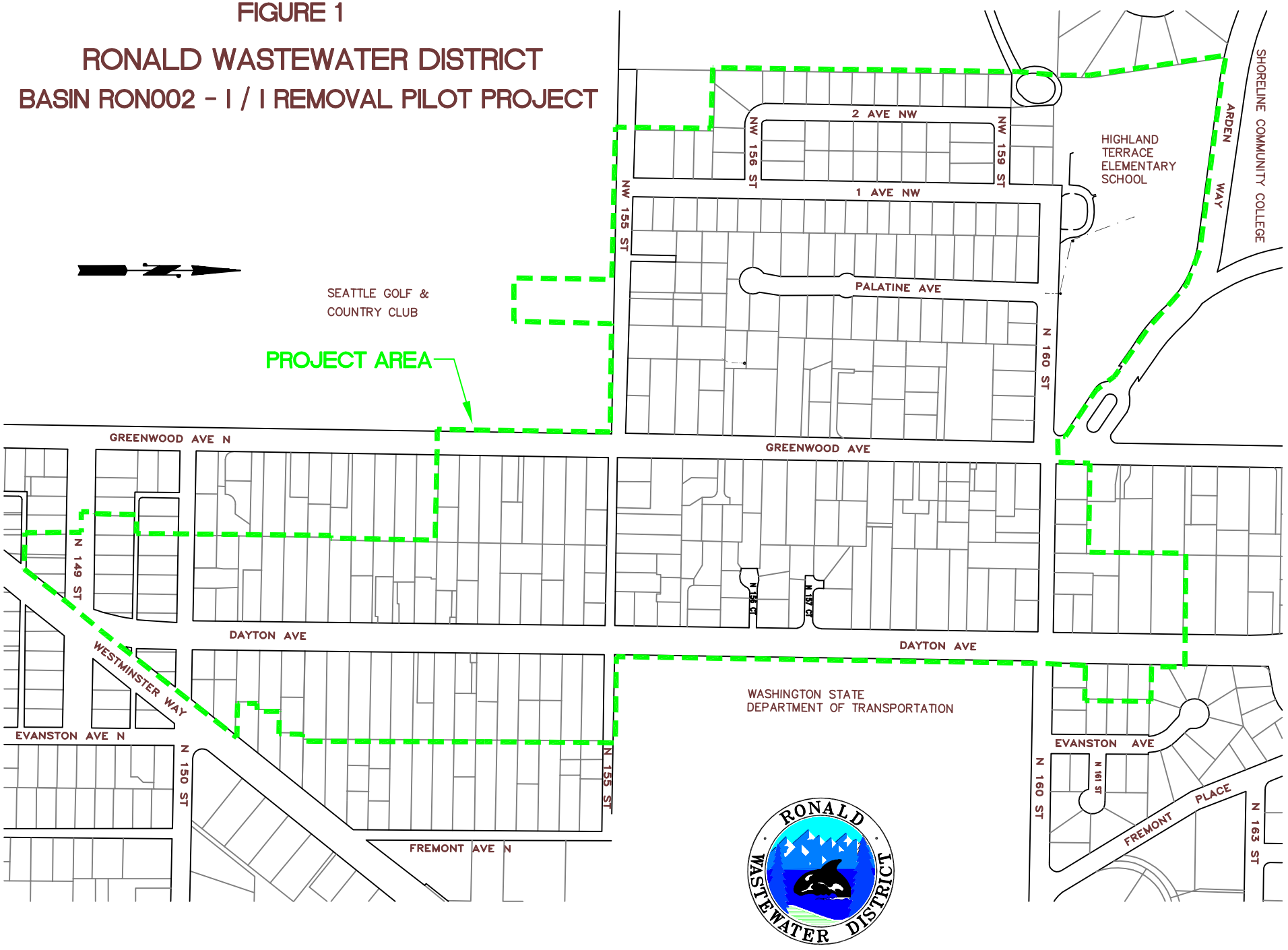
Prior to this pilot project, KCWTD completed flow monitoring throughout its conveyance system and within the collection systems of each of the component agencies served by the County's wastewater system. I/I rates were estimated for each monitored basin and the results shared with the component agencies.

In late 2001, the County issued a Request for Proposal to component agencies for selection and funding of $900,000 for pilot projects that use any combination of trenchless technologies to decrease I/I. RWD, being a component agency and already having an I/I program in place since the 1990s (information was readily available), proposed pipebursting all side sewers and providing an additional $900,000 of its own funds.

FIGURE 1

RONALD WASTEWATER DISTRICT

BASIN RON002 - I / I REMOVAL PILOT PROJECT



The project began in May 2002 and was substantially complete in December 2003. The District's engineer, CHS Engineers, served as project manager, designer and construction manager with support from District Managers and staff, and oversight by KCWTD. The construction was performed by BUNO Construction of Snohomish, Washington.

Prior to beginning this project, KCWTD completed flow monitoring throughout its conveyance system and within the collection systems of each of the component agencies served by the County's wastewater system. I/I rates were estimated for each monitored basin and the results shared with the component agencies. As an element of the RWSP, funding was allocated for I/I removal pilot projects. Component agencies proposed pilot projects in specific basins, utilizing various I/I removal techniques. Ten basins/projects were selected for implementation and each was funded by KCWTD. RWD provided additional funds to complete the proposed work throughout the selected basin. Following completion, flow monitoring and hydraulic/hydrologic modeling will be performed by KCWTD to estimate the amount of I/I removed in each basin (i.e. corresponding to each I/I removal technique). Comparing the cost of such removal to the cost of conveyance and treatment will help the County determine the effectiveness of each technique.

The effectiveness conclusions and other information gathered in all the pilot projects will support decision-making and future efforts for I/I removal by RWD and KCWTD.

RWD's pilot project basin is approximately 100 acres in area and primarily consists of single family residential properties. There is also one commercial property, one apartment building, a few duplexes and one public elementary school. The basin does not receive wastewater from an upstream sewer basin, and all wastewater leaves the basin at a single point (RWD Manhole A70). The basin includes approximately 12,500-feet of 8-inch diameter sewer main and approximately 23,000-feet of four and six-inch diameter side sewer and stub piping. [1] Approximately 500-feet of the sewer main is PVC pipe with the remainder constructed of concrete pipe.

Flow monitoring indicated that this basin had significant I/I: approximately 11,000 gallons per acre per day. However, previous RWD sanitary sewer evaluation work in this basin (sewer main inspection and smoke testing) revealed relatively few faults. Only seven sewer main faults were noted and about 10 faults on private property were noted which could allow I/I. None of the observed faults contributed to significant I/I. Therefore, the supposition was made that the source of I/I must be in the side sewers and stubs, so those were identified as the focus for the work of the pilot project.

As indicated above, this report summarizes the activities and observations for each of the six project elements. Recommendations are then presented after discussion of activities and observations. Project cost summary information is presented at the end of the report.

[1] For this project, the "side sewer" is defined as the private pipe between the building connection and the right of way or public sewer easement and the "stub" is defined as the public pipe extending from the sewer main to the right of way or public sewer easement.

1. Project Management

The first element of the project was project management. Project management includes the work of planning, implementing, monitoring, controlling, and closing a project. A project plan was developed, including a project scope, schedule and budget. The scope described the work in each project element, the details thereof, the schedule, and the budget for each task. Project management activities are summarized as follows:

1.1. Activities

1.1.1. Quarterly Monitoring Reports. Five quarterly reports were prepared by CHS to report progress and activity to RWD and KCWTD. For each of the six project elements, the reports described the work of the prior quarter, work for the upcoming quarter, budget and schedule status and identified changes or challenges in the project implementation. Budget and schedule were monitored using the "earned value" method of project monitoring. This method compares actual cost and progress to planned or budgeted costs and schedule to quantify cost and schedule variances at each monitoring milestone.

1.1.2. Monthly Review. CHS updated the budget and schedule element of the quarterly monitoring report each month to regularly monitor progress and costs. This monthly review allowed adjustment in effort or resources to adhere to the planned budget and schedule or to allow prompt adjustment of the original schedule or budget as appropriate.

1.1.3. King County Coordination. This task included meeting and corresponding with KCWTD regarding the interlocal agreement between the County and RWD, and included design and construction phase coordination and review.

1.2. Observations

The effort for monthly and quarterly monitoring was somewhat underestimated, and the scope of KCWTD reporting requirements changed during project implementation. For example, only one County plan review was anticipated yet two reviews at two stages of design completion were required: one each by the County and one each by their consultant. Once construction began, more specific progress reporting and project document sharing was requested by the County (e.g. copies of shop drawings, daily reports, etc.). Additionally, KCWTD indicated they would prepare the SEPA checklist but requested significant support from RWD and CHS to complete the checklist for this project. These changes resulted in higher than anticipated costs in the King County Coordination task. Also, because the engineering and construction work was combined in the construction element of the budget monitoring tool, another challenge was distinguishing construction budget status from engineering budget status during each monthly review.

2. Predesign

The goal of this element was to collect and manage data that was to be used in the design phase.

2.1. Activities

2.1.1. Review Sewer Main CCTV Records. The District had inspected almost all the sewer mains in previous years and any outstanding inspections were

completed by District crews. Once all the inspections were gathered, the faults were prioritized according to Table 1. Only Priority 1 & 2 faults were considered for repair. Typical main line faults/conditions found were roots, cracks, gaps, and unused side sewers stubs.

Table 1: Main Line Fault Priority

Priority	*Description*
1	*Inflow sources, including heavy flows*
	Structural faults (main line, side sewers or manhole) (>1-inch opening)
	Stub tee fault, main line fault
	Heavy, moderate I/I
2	*Structural faults, cracks (<1-inch)*
	Manhole joint
	Light I/I
3	*Hairline cracks*
	Belly
4	*Roots/grease/debris*
	Mineral deposits
	Manhole not accessible
5	*No faults identified - Reinspect within 5 years*
E	*Investigate source of flow - possible fault?*
	-District camera could not fit
	-flow too heavy to complete inspection

Manhole inspection was an additional related task required by KCWTD after project initiation. Although District staff had completed general manhole condition assessments with their closed-circuit television (CCTV) work, KCWTD wanted more specific and better-documented inspections. An inspection form developed with guidance from KCWTD, and RWD staff completed the inspections accordingly. CHS reviewed and summarized the findings, including recommendations to raise one (1) manhole to grade and to reinstall one (1) offset frame and cover. This work was completed by RWD staff.

2.1.2. Records Research. Various records were gathered from County and District files. Each type of record was reviewed and compared to other records for use in the predesign and design work:

- T-sheets, side sewer as-builts, quarter sections (CAD drawings), and white cards were obtained from the District. White cards show similar information as the quarter sections.

- The latest versions of King County Assessors' maps were obtained. The maps were used in conjunction with parcel search information from King County's eReal Property System (http://www.metrokc.gov/Assessor). Property lines, right-of-way (ROW) lines, easements, etc. on quarter section maps were compared against Assessors' map information. Property ownership was verified with parcel searches to determine tract ownership (e.g. easement vs. shared tracts).
- Kroll Maps were obtained, but were not used because they were older than quarter sections.
- An aerial photo (circa. 2001) was obtained. It was used as a visual aid only.
- A U.S. Soils Survey was obtained. It revealed that area is underlain by Alderwood gravelly sandy loam, rolling (6-15% slope) – considered to be moderately well-drained soil.
- FEMA Flood Insurance Maps were obtained and revealed that entire basin is outside the 500-year floodplain.
- King County provided a preliminary environmental review for the project area. The review indicated the potential for petroleum-contaminated soils and/or groundwater in the vicinity of a commercial property (presently unused) formerly occupied by a service station. The existing side sewer and stub had been completely inspected by CCTV, with only one fault at the ROW line (6-inch to 4-inch transition). It was decided to avoid work in this area due to potential cost of pollution prevention and the undetermined use of the subject property.

2.1.3. Base Map Development. The CAD quarter sections were used to develop the contract drawing base map. Through a combination of site visits, comparison of side sewer as-builts (some properties had since been remodeled or redeveloped), field observations, and CCTV records (some stubs had since been abandoned while others had since been constructed), corrections were made to stationing and alignment on the quarter sections. Property lines, easements, addresses, etc. were also updated following review of Assessors' maps and District records.

2.1.4. Side Sewer and Stub CCTV Inspection. Pipe Experts LLC was contracted to inspect side sewers and/or stubs and to mark stub locations at the edge of the ROW. A side-launch (main line) camera equipped with a sonde was used. The side launch camera had a cable length of 80-feet. They produced video tapes (VHS) with inspections of all nearby stubs, inspection logs documenting observations (and corresponding stub/side sewer stationing), depth at locates and main line stationing, and marked with wooden stakes, nails, or paint to mark the location of the stub at the estimated edge of ROW.

2.1.5. Review Construction Method. The primary method selected for side sewer replacement was pipebursting because of its generally lower level of surface disturbance compared to open-cut restoration. Therefore, the efforts of this activity focused on confirming the feasibility and cost-efficiency of pipebursting for the variety of side sewer alignments and conditions in the project area. The primary questions were: replace stub and/or side sewer,

feasible/cost-efficient depth for pipebursting, and how to pay for pipebursting with varying conditions on each property.

Concrete side sewers/stubs were designated for replacement, regardless of condition and/or knowledge of any faults. PVC and ABS side sewers/stubs were specified for "Inspect Only" assuming a much lower prevalence of faults resulting in infiltration. Each stub/side sewer inspection was reviewed to decide if the pipeburst should originate from the main or from the property line. If faults were found in the stub within 3-feet of the main, then a "pipeburst from main" (Type C replacement for 4-inch, Type D replacement for 6-inch) was specified. Otherwise, a "pipeburst from property line" (Type A replacement for 4-inch, Type B for 6-inch) was specified. Multiple Type A's or B's were specified for each property if it had a side sewer with bends greater than 45 degrees because another insertion pit was assumed to be required. For Type C's and D's, 12-feet deep was assumed to be the limit of practical excavation, in which case a cured-in-place (CIP) stub/side sewer lining (T-Liner®) was specified. T-Liner® was chosen for its ability to line the stub and around the stub opening into the main line. The data was summarized in a spreadsheet.

2.2. Observations

2.2.1. In general, T-Sheets were the least accurate and the District's CCTV logs were the most accurate in terms of side sewer stationing. Pipe Experts' stationing was reasonably close to the District's records, accounting for calibration and start point. Some analysis was required to verify or deduce if a side sewer existed, given the variety of sources.

2.2.2. Sharp bends and constraints in pushing the camera upstream with limited directional control (side-launch camera) and only 80-feet of cable limited the extent of stub and side sewer inspection. Pipe Experts' three-man crew (one camera operator, two laborers) completed inspection of about two or three main lines (manhole-manhole) in one day (approx. 14 stubs/day). The laborers traced and marked the camera position and read the depth at the ROW line.

2.2.3. The knowledge of the ROW line location, inconsistent mark placement, electrical interference (of sonde reading), and depth of main limited the accuracy of, or in some cases the ability to obtain, the horizontal and vertical location reading of the side sewer.

3. Public Relations

The goal of this element was to involve and educate the public, secure permission to work on private property, and to coordinate with the City of Shoreline.

3.1. Activities

3.1.1. Public Meetings. Three public meetings were held at the Highland Terrace Elementary School gymnasium. The purpose of the meetings was to provide information to property owners and offer a forum for questions, answers, and discussions during the design process. The first meeting introduced the topic of I/I, what the County and District were doing about it, and why the attention is focused on this basin. The agenda for the second and third meetings was to both provide background information (as presented in the

first meeting) and to build on the first meeting. Computer slide presentations and display maps were used at each meeting. Also at the second and third meetings, a video was presented to show the pipebursting process. Coffee was provided for attendees and coloring/educational materials were available for their children. The following are types of communications that were attempted prior to, during, and following the public meetings.

- Informational flyers. Notices were mailed to each property owner two weeks prior to each of the public meetings. The first notice was a letter-sized colored flyer identifying the project boundary. King County paid for the copies and mailing of the first flyer. The second flyer was on an 8½-inch x 5½-inch bright colored flyer announcing the meeting and referencing the Right of Entry (ROE) Mailing (see ROE discussion below). Two different postcards were mailed depending on whether the owner's ROE had been received or not. A final colored flyer was sent out prior to the third meeting. The District paid for the copying and mailing of the flyers for the second and third meetings.
- Internet. A web site was developed prior to the first meeting and was updated following each of the public meetings. The web site was developed and maintained by King County with information provided by the District. The site included: project boundary, a construction schedule, and frequently asked questions (FAQ), which were developed from the public meeting discussions. A point of contact at both Ronald Wastewater District and King County was included on the website. Photos of the construction project were added once the construction was underway. The website was modified as more King County I/I projects got underway. The website was again updated following completion of construction to reflect the work that was performed.
- Questionnaires. A questionnaire was handed out at public meetings. Owners were asked basic questions: if there were previous sewer problems; if there was a basement or sump pump on the property; if the gutter, downspouts and yard drains were connected to the sewer; if the side sewer had every been modified; and if there were any manholes or cleanouts on the property.

  The District mailed a simple post-construction questionnaire to the participating property owners. Seventy-six (76) responses were received. It asked property owners' input by responding to eight (8) questions on a scale of 1 to 5:

  1 – Very Unsatisfied
  2 - Unsatisfied
  3 – Satisfied
  4 – Very Satisfied
  5 – Does Not Apply

  The questions, along with satisfaction ratings (i.e. "3" and "4" responses) are presented in Table 2. (Not every respondent answered all questions. The percentages presented below are based only on answers provided.)

Table 2:Questionnaire Satisfaction Results

Question	Satisfied	Very Satisfied
Meetings conveyed project description	23%	35%
Meetings were conveniently timed	33%	27%
Meetings were at a convenient location	29%	33%
Advance notice was adequate	36%	42%
Work was completed promptly	23%	51%
Contractor was responsive to feedback	25%	44%
Disturbance level was reasonable	39%	44%
Work performed was understood	35%	43%

- Door hangers. The District staff placed door hangers two days prior to the second meeting on all the properties that had not yet turned in their ROE (see ROE discussion below). A second set of door hangers was distributed prior to the contract going to bid to the few properties that had yet to sign a ROE.
- Project signs. A total of 5 project signs were installed prior to construction by the Contractor at different access routes into the basin. It included: project name, contact name and number, District logo and King County logo. The City of Shoreline reviewed the sign layouts. King County paid for the sign fabrication.

3.1.2. Rights-of-Entry. Included in the second mailing to each homeowner in the project area was a ROE form, handout from the first public meeting, questionnaire, a list of FAQ, a District-addressed and stamped envelope, and a cover letter explaining what the District was asking of each resident. The District paid for this mailing.

3.1.3. Stormwater Management. Early in the project the District and County met with the City of Shoreline Public Works Director regarding stormwater management. The primary issue was the impact of I/I removal from the sanitary sewer system on private property and/or the existing storm drainage system. The District's position was that runoff is a City or property owner responsibility but that the District would consider some level of support to the property owner if the side sewer replacement and/or disconnection of illegal connections results in drainage problems. The parties recognized the challenge of knowing whether drainage problems are directly related to the side sewer replacement work

3.1.4. Right of Way Permit. CHS consulted with the City ROW inspector early in the design process to coordinate the permitting procedures and standards for road restoration. Contract language and restoration details were drafted for the City's review prior to bidding the work.

3.2. Observations

3.2.1. Attendance at the first two public meeting was about fifty (50) people each meeting. Fewer residents were in attendance at the final meeting. Very few children attended.

3.2.2. Although property owners were told that the project was 100% funded by RWD and KCWTD, their main concerns were out-of-pocket expense and property damage/restoration. Of particular concern was the area of disturbance of concrete or asphalt surfacing and mature vegetation.

3.2.3. Many property owners claimed they had not been notified about this project. For those properties that had not signed their ROE forms prior to the third meeting, the District personally contacted the residents. Contact with property owners was attempted a total of six (6) times.

3.2.4. A total of 153 questionnaire responses were received prior to the predesign report. The results were tabulated by the District for use in the predesign element.

3.2.5. Approximately 116 of the 290 (40%) of potential properties' ROEs were received prior to the second public meeting. Prior to the project going to bid, a total of approximately 246 ROEs had been received, or 85 percent of the total number of residents in the area. Although it was not, in the end, an issue on this project with the high level of participation, there is the potential issue of participation by less than all parties to a jointly used side sewer. The District's attorney concluded work could not be performed on a joint side sewer unless the right-of-entry was executed for the property on which the joint side sewer was physically located.

3.2.6. The contract was bid with 247 properties having signed ROEs. Additional property owners signed their ROEs after start of construction, other parcels dropped out during construction, bringing the total to 261 of the 290 properties (90% participation) in the project area.

3.2.7. Stormwater Management. Late in the design process and again early in construction, CHS and the District discussed potential reasons why a property owner may not sign a ROE, particularly owners that knew of, or suspected, illegal connections to their side sewer and were reluctant to participate in the project. Although stormwater connections to the sewer are prohibited under District code, they have not been enforced in the past because of a number of unresolved enforcement issues. (Educating the public was the primary means of enforcement in the past.) A potential conclusion is that there may be more unknown illegal connections. A challenge of such a project is obtaining permission to find and remove illegal connections.

3.2.8. Right of Way Permit. The pre-bid coordination with the City resulted in timely approval of the ROW permit, without unexpected conditions.

4. Design

The goal of this element was to analyze the data gathered during predesign, make informed design decisions and complete contract documents under KCWTD oversight.

4.1. Activities

4.1.1. Plan Preparation. Due to the large quantity and variety of side sewer replacement work, drawings had to be as clear and concise as possible. A detailed field survey was not completed, assuming it would be too expensive (and time-consuming) to obtain ROEs for such survey (not all ROEs for construction had even been obtained yet). Furthermore, the private side sewer alignment was unknown. Therefore District quarter section maps (includes ROW, property line, house footprint and sanitary sewer system) were used as the drawing base map. Participating properties were shaded and all proposed work was specified in tables. Throughout the project, "Table A" was used to specify stub/side sewer work and "Table B" was used to specify main line repair work. Houses were visually inspected for basements and split-levels. A house with a basement would mean the sewer connection would be deep. The tables included pertinent information such as approximate depth (excavation) and existing pipe material. Site observations were compared with questionnaires received as the plans were developed.

4.1.2. Specification Preparation. Special attention was given to pipebursting, cured-in-place (CIP) tee and stub lining (T-Liner®), and main line CIP spot repairs. Specifications were also prepared for mechanical sleeves for main line repair, but BUNO chose CIP liners instead. Various combinations of fittings and couplings were researched (e.g. shear resistance, outside diameter compatibility, etc.). District standard details were used and modified, as needed, for anticipated site and construction conditions. Cleanout locations were analyzed and reviewed. The decision was made not to install cleanouts at the property line.

4.1.3. Construction Cost Estimate. Estimated costs were prepared for the final list of bid items based on consultation with local contractors.

4.1.4. King County Review. The County and their consultant reviewed the contract documents at two stages of completion.

4.2. Observations

Writing a universal measurement and payment for pipebursting was difficult due to various site conditions (e.g. depth, length, bend, surface improvements, etc.). Different scenarios were considered but the work ultimately focused on four pipebursting replacement configurations, with separate items for cleanouts, paving, etc. The intent was to capture the core work effort on one property, which is mostly associated with digging holes for pipebursting and is somewhat removed from the length of pipe replaced.

5. Bidding/Contracting

The goal of this element was to advertise for and contract with a contractor per public works bidding requirements.

5.1. Activities

5.1.1. Advertisement. The Board of Commissioners gave authorization to bid. The project was advertised in The Daily Journal of Commerce (two times). CHS distributed the contract documents and the planholders list and answered potential bidders' questions

5.1.2. Received/reviewed bids. The District received the bids and CHS prepared a bid tabulation (see Appendix) as part of recommendation for award. The low bidder's contracting license, pipebursting license, experience, and references were also reviewed.

5.1.3. Contract Award. Contract documents were prepared for contract execution following award by the District.

5.2. Observations

5.2.1. Four bids were received. The Engineer's Estimate was $1,470,610.00 (w/o tax). The Contractor (Buno Construction, LLC) had the low bid of $1,154,660.00 (w/o tax) and was awarded the contract/project. The average unit prices bid for pipebursting (excluding highest bid price for each item) were:

- $2,400 for 4-inch pipeburst from ROW to house connection (Type A)
- $2,700 for 6-inch pipeburst from ROW excluding house connection (Type B)
- $3,800 for 4-inch pipeburst from sewer main (including tee) to house connection (Type C)
- $4,400 for 6-inch pipeburst from sewer main (including tee) excluding house connection (Type D)

(These construction cost figures do not include mobilization, backfill gravel, crushed rock, asphalt/concrete surfacing restoration)

5.2.2. The District's contract language was too vague regarding pipeburst contractor's required qualifications. It did not differentiate between company experience vs. company personnel experience. Debco, a prior company of the Buno family, had extensive experience with pipebursting, but BUNO Construction (the current company only a few years old) did not have the specific required experience.

6. Construction

6.1. Activities

6.1.1. Preconstruction/Mobilization. A preconstruction meeting was held at the beginning of construction. Guidelines were set at the meeting for progress meetings, shop drawing submittals, required certifications, and progress payments. Progress meetings were held at the beginning of each month (from May until October). Shop drawings of the proposed construction materials were received and reviewed. Contractor certifications (CCTV and pipebursting) were reviewed. Quantities were tallied in a spreadsheet. Progress reports were sent to the County and District along with each progress payment. The District's report summarized the quantities-to-date (pipebursting, "Inspect Only", Main Line Repairs) and detailed any problems. The County's report summarized quantities and detailed problems with installation, system testing, and contractor performance, field changes and change orders.

6.1.2. Side Sewer Inspections. All side sewers were inspected, regardless of any prior inspections, primarily to find location of piping/connections and to document faults. Inspection review and approval prior to replacement was required by the Contract, but was waived because it would be too time-

consuming (side sewers were replaced regardless of condition). Illegal connections were found by pouring water into suspect drains and watching for a corresponding flow using the CCTV camera.

6.1.3. Side Sewer Replacement. BUNO's basic methodology for a pipeburst replacement was:

- Dig holes at the upstream end (typically the house connection) and downstream end (typically at the property line or at the tee) to expose the pipe,
- Thread a cable (from the winch) though the pipe from the downstream end and connect the bursting head to the end of the HDPE pipe, then connect the bursting head to the cable,
- Use the winch to pull the pipe (in the downstream direction) then wait for pipe to relax after the bursting head reaches the downstream pit,
- Cut the pipe at both ends and connect HDPE pipe using adapters/couplings.

BUNO was able to complete 3 to 4 pipebursts (properties) per day on average, due mostly to his ability to pipeburst around bends and pipeburst two (2) – 4-inch pipes through one (1) – 6-inch common concrete pipe (thereby giving each house a separate side sewer to the main). BUNO was still paid according to pipeburst work specified (multiple pipebursts, if applicable), but not for any other appurtenances consequently not required (e.g. cleanouts, etc). Short sections of side sewer (bends, etc) were replaced by open cut.

Portions of the contract work were revised as necessary to suit unanticipated conditions different from the plans (e.g. backfall in existing pipe, different alignment, restoration issues, etc.). T-Liner® work was replaced with a combination of pipebursting and Top Hat™ System (a CIP liner product for the stub/tee only) repairs.

Fifteen air tests were performed. (Only the installed portion of HDPE pipe was tested.) The pipe was tested for retention of air pressure for 3 minutes and all tests were successful.

Property owner complaints (e.g. construction, restoration, etc.) were routed to BUNO from the District through the Engineer. Progress on complaint resolution was tracked and recorded by the District .

6.1.4. Main Line Repairs. CIP spot repairs were used to rehabilitate the main line. Gelco Services was subcontracted by BUNO to do the work. Each repair is 3-feet long and was applied using remote control robotics/CCTV camera.

6.1.5. Manhole Repairs. The District crew raised one manhole to grade in the gravel shoulder of Dayton and reset an offset manhole frame on the sewer serving the Highlands golf course.

6.1.6. Restoration/Record Drawings. BUNO was responsible for recording "as-built" conditions of the side sewer. Information, such as length of pipe, type of fitting(s), and distances/offsets, was recorded on CAD sketches of each property provided by the Engineer.

6.2. Observations - General

6.2.1. The progress meetings were beneficial for the County and District to allow them to review BUNO's progress and to refine the Contract document requirements in the context of field conditions.

6.2.2. Due to the Contractor's confusion on the scope of some bid items (i.e. what work was actually encompassed in each bid item in the context of various property situations), CHS took the lead in documenting completed quantities for review by the Contractor. Several meetings were held for the purpose of reconciling fair compensation.

6.2.3. Approximately 107 of the 160 inspected (67%) side sewer stations[2] (regardless of number of services) had at least one fault (e.g. roots, crack, etc.). There are 188 side sewer stations in total (i.e. not all side sewer stations were inspected).

6.3. Observations Pertaining to Public Relations

6.3.1. More property owners signed up for the project as construction progressed. Three properties signed up because they saw that side sewers on neighboring properties were being replaced. Others signed up (after project commencement) because they were reportedly not aware of the project and the inspector informed them of it.

6.3.2. Some property owners were prompt to sign restoration releases, but others did not sign it for fear of something happening after project completion. Approximately 26 releases required additional effort by the District and BUNO to satisfy the homeowner. In some cases, BUNO made up to five (5) attempts to get the restoration release, but the property owner was unreceptive. Of the received restoration releases, some signatures were illegible and/or not signed by the legal owner (e.g. tenant, parents, etc.). In some cases, the owner recently purchased the house and District records had not been updated.

6.3.3. BUNO missed some "additional house connections" (i.e. connections other than at the end of the side sewer) and had to go back to reinstate them. Usually these were found by the property owner requiring immediate response by BUNO.

6.3.4. Several property owners experienced plumbing problems and questioned if it might be due to construction. Only one was discovered to be a result of pipebursting two-4-inch lines together through an existing 6-inch concrete pipe. A belly was created and later removed. Post-installation inspections were valuable in evaluating the property owner's claim for damages. (The other property owner was directed to call a plumber.)

6.3.5. The District provided assistance to 121 N 156th St. in stormwater management. A downspout and yard drain were illegally connected to the side sewer. It was disconnected and a french drain was constructed (under force account) to divert the runoff. With one exception, all other illegal

[2] Side sewer stations were used for comparison rather than individual side sewers because multiple upstream (4") side sewers share a common 6" stub. If any of the individual 4" side sewers were defective then the 6" pipe would be considered defective.

connections found were disconnected without further remedial work or District financial support.

6.4. Observations Pertaining to Design

6.4.1. The Contract required the pipeburst replacement to reach the house plumbing connection. After completing the first few pipebursts, this requirement was relaxed because it would be unnecessarily more disruptive for the property owner and, in some cases, result in higher restoration costs. (The pre-installation inspections showed that the existing pipe condition upstream was in good condition.) Similarly, side sewers that were under building foundations (house extensions) were not replaced because it was considered private plumbing. Examples where pipebursting did not reach the house connection were: house extensions, awnings, wood decks, concrete patties/sidewalks, stairs, mature vegetation, etc.

6.4.2. A push camera, equipped with a sonde, was inserted from a downstream open pit. By inspecting from the downstream end, the camera was able to reach all branches of any wyes. The camera cable was 200-feet long, but the extent of inspection often depended on how many bends and fittings the camera had to pass through. The further upstream the camera was, the harder it was to push. The furthest upstream the camera reached was approximately 130-feet. Sometimes, BUNO would inspect from the upstream cleanout if it was too difficult to do so from the downstream pit. "Inspect Only" properties were inspected from cleanouts. Twenty-four (24) properties were not inspected because either a cleanout could not be found or it was inaccessible.

6.4.3. Illegal connections were found by pouring water in nearby downspouts, yard drains, etc. and watching for any flow out of the corresponding suspect wye. Other common illegal connections were driveway and foundation drains. Eleven (11) illegal connections were found; ten (10) of them were disconnected:

- Five (5) were simply disconnected from the side sewer, following property owner notification
- One (1) was disconnected and diverted to splash blocks
- One (1) was disconnected and diverted to a french drain (payment under force account)
- Two (2) were disconnected and diverted using permanently installed sump pumps discharging to the street. Costs were shared by BUNO, the District and property owners. These costs are not included in the summary at the end of this report. The estimated cost for each sump pump installation (including discharge pipe and electrical service) is approximately $2000.
- One (1) was disconnected and the property owner was responsible for redirecting the drainage (driveway drain at 15538 Greenwood)
- 15730 2nd Ave (slotted drain behind house) still has an outstanding illegal connection. See Section 6.4.9 below.

Disconnection of illegal connections was challenging due to the variety of field conditions at each property. Solutions varied for each site depending on topography, proximity to or existence of site or roadway storm sewer system, existing private or public improvements. Other than diverting

downspouts to splashblocks, each disconnection required a site-specific response

6.4.4. BUNO suggested stiffening inserts (for HDPE mechanical joints) and bead removal (of the HDPE fused joints) should not be required. His claim was researched, verified to be reasonable and accepted.

6.4.5. Excavation plans (required by the Specifications) were waived at the request of BUNO because of the large number of homes. No problems were caused because of waiving this requirement.

6.4.6. DFW (brand name by NDS, Inc.) couplings were used instead of Fernco Strong Back RC Series Couplings after BUNO proposed that the DFW coupling forms a tighter connection than the Strong Back and the crew constantly cut themselves using the Fernco metal ring. Specified Fittings (brand name), a push-on adapter, was specified for the house connection, but was not used because of rigid pipe end conditions (not possible to connect).

6.4.7. Cleanout covers were originally specified as slip-on spigot adapters. BUNO originally installed them without glue. The effectiveness of such an assembly was discussed and a gasketed plug/bell cleanout assembly was chosen instead. BUNO was instructed to go back and glue all previously slip-on cleanout cover/coupling as a result.

6.4.8. Short lengths of side sewer that wrapped around the back of a house (< 4-feet deep) were open-cut (PVC installation) instead of pipeburst.

6.4.9. Site conditions may dictate a rehabilitation type different from what was specified (e.g. the tee may be in good condition, difficulty accessing tee, etc). Nine (9) properties were omitted from pipebursting:

- 15722 and 15730 2nd Ave: The 6" common lies in 15722 and the property owner did not want yard disturbed. The side sewer for 15730 consequently was not replaced. The 6" common and 4" for 15722 were inspected and determined to be in satisfactory condition. An illegal slotted yard drain connection was found at 15722 during inspection. Since the inspection pit was already excavated, only the tee at the main was replaced with PVC.
- 15540 Palatine Ave: Cleanout and house connection is under exposed aggregate concrete (too expensive to restore). The side sewer was inspected and determined to be in satisfactory condition.
- 15710 and 15714 Greenwood: There was an unrecorded shift in property line between the two lots on the District quarter section. The 6" common (which was supposed to be in 15710) is now in 15714 and underneath a driveway. The property owner of 15714 did not want the driveway disturbed. The side sewer for 15710 consequently was not replaced The 6" common was inspected. The tee to 15714 is in poor condition. Since the inspection pit was already excavated, only the tee at the main was replaced with PVC.
- 346 N 149th St: The access pit would have required removing mature hedges that act as a traffic noise (along Westminster Way) barrier. BUNO was not confident in restoring the mature hedge (too expensive to restore). The side sewer was inspected and determined to be in

satisfactory condition (the side sewer on the south side of the house is PVC)

- 14919 Dayton: The house is too close to the main line (approx. 20'). BUNO was not able to inspect it, but review of Pipe Experts' video showed that it was in satisfactory condition (Pipe Experts' video reached the house connection).
- 15030 Dayton: The tee branching from the 6" common is under a mature tree. BUNO was not confident in restoring it.
- 411 N 155th St: There was an unrecorded change in the house footprint. The house connection is most likely underneath the house and the edge of the house is too close to the main line. It was not inspected, but a cleanout was installed for future access.
- 423 N 157th Ct.: The stub was already PVC pipe (good condition). The original proposed work (T-Liner®) was to seal an improper/substandard connection to the main (the PVC pipe was just stubbed-in to the concrete main with rubber gasket). When it was realized that T-Liner® would not be used (see below), a Top Hat™ was used.

6.4.10. BUNO proposed to pipeburst side sewers deeper than 12-feet originally specified for rehabilitation using T-Liner®. His proposal was accepted with conditions. Eight (8) side sewers were still designated to be rehabilitated by T-Liner® because of access difficulties, etc. In the end, T-Liner® was not used because of subcontractor delays and too many requirements from the supplier. Consequently, force account work involving pipebursting and Top Hat™ was proposed and accepted to complete the project.

6.4.11. Restoration of asphalt patches was done in batches (vs. per-property basis) to reduce cost. This resulted in delayed restoration on individual properties.

Driveway restoration was of particular concern at 15706, 15708 and 15710 Greenwood and 15528, 15534, 15536 and 15538 Greenwood. The owners claimed damages to an already damaged driveway (preconstruction photos showed that they were in poor condition already). They complained of such damages as: oil spots, scrapes/gouges, cracks, holes, gate malfunction, murky tap water and disruptions to other utilities. The District agreed to complete seal coating and some additional repair.

6.4.12. Tracking extra excavation depths of the many excavations (one of the bid items) proved to be difficult, especially at the fast pace of construction.

6.4.13. A belly was found in one of the replaced side sewers. The cause has not been confirmed, but this is a reminder that pipebursting is not an exact installation method. The existing pipe slope and/or alignment, soil condition and other constraints ultimately control the final line and grade of the replacement pipe. The belly has since been repaired.

Recommendations

The following recommendations address only how work of similar projects should be address differently than as on this project. If not addressed specifically below, the

recommended approach (on a similar project) would be the same as in the "Activities" sections above.

1. **Project Management**
   1.1. We recommend including more detail in the project plan and scope regarding project management reporting and coordination, especially if more than one agency is involved. More discussion in the planning stage could have resulted in a better understanding of the level of coordination appropriate for the project. The earned value-monitoring plan should include separate line items for engineering and construction or other significant tasks to be monitored. The subtasks for the construction phase should be defined in more detail.
2. **Predesign**
   2.1. In order to get the most accurate CCTV information possible, only North American Association of Pipeline Inspectors (NAAPI) or Pipeline Assessment and Certification Program (PACP)-certified CCTV inspectors should be hired (although this requirement is difficult to enforce given the wide range of experienced CCTV inspectors).
   2.2. CCTV stationing measurements should be calibrated by comparing the camera distance counter with predefined distance on a flat surface. The Contract should specify: maximum and minimum camera speeds, camera height, minimum resolution, etc.
   2.3. The appropriate ROW line should be marked ahead of time or information should be given to the inspection crew to correctly identify the ROW. Field locates should be made at the anticipated excavation, regardless of proximity to the ROW (i.e. a locate behind a rockery or at the base of a tree is not useful if excavation will be in the shoulder of the road).
   2.4. The measurements made to reproduce the stub location at ROW were tedious and often not used during construction. Usually, the photos were used to approximate/re-mark the locate. The measurements were used only in cases where identifiable benchmarks (e.g. dense trees, brush, etc.) were around.
3. **Public Relations**
   3.1. The timing of the public meetings (November-January when the District was attempting to receive ROEs prior to advertising for bid) was not good. For a project as large as this, the public meetings should occur outside of the holiday season.
   3.2. The Web page was nice to have with this project and the direct mailings and door hangers resulted in large number of ROEs being returned.
   3.3. Inform property owners about the potential for waterline breaks and the consequent silt and debris that may show up in their water supply.
   3.4. Inform property owners about the potential for minor and superficial marking on the pavement by construction equipment. Property owners should also be notified that pipebursting does not correct bellies.
4. **Design**
   4.1. Dissimilar rehabilitation methods should not be grouped together into the same contract.
   4.2. Consider a budget for seal-coating private driveways.
   4.3. The Contractor should be required to install rubber tracks on excavators.

4.4. The measurement and payment approach used in this project, with some reduction in minor bid items, or a unit-price-per-property approach (includes all replacement work, regardless of length, depth, alignment, etc.) should be used. Describing an appropriate measurement and payment for side sewer replacement by pipebursting was challenging. The properties have a variety of site conditions and the final number of participating properties may not be known at time of bid. In any event, accurately and completely describing the work in the unit price is imperative so contractor claims can be minimized.

4.5. The Contractor should be prepared to pipeburst in any soil condition.

4.6. The extent of pipebursting may not always reach the house connection and is determined by other factors such as cost, owner concerns, and disturbance.

5. Bidding/Contracting

5.1. Include more specific pre-bid qualifications or bid submittal requirements regarding certifications, project-related experience, etc.

6. Construction

6.1. The property owner should preferably be present during construction so he/she can assist the Contractor (e.g. flushing the toilet, operating washing machine, etc) in looking for active/inactive connections.

6.2. Pre-construction side sewer inspection should be required. However, submittal and review of the tape prior to replacement work commencing should not be required (to expedite construction) if all side sewers are to be replaced.

6.3. One of two approaches for securing restoration releases should be used. In this contract, the Contractor was required to complete restoration on each property, then secure a signed restoration release (indicating that the property owner was satisfied with restoration). In the end most releases were signed, but several remained outstanding for various reasons (e.g. owner could not be contacted, uncooperative owners in spite of reasonable restoration efforts, etc.). BUNO recommended an approach used by another agency on a similar project. He recommended that the ROE include contract language that the property owners perform all restoration at their own cost, following backfill of any excavations. The rationale is a "free" side sewer replacement in exchange for one's own restoration work. Either approach (this project's or BUNO'S recommended approach) warrants consideration.

6.4. The restoration release should state that it only be signed by the legal owner and ask for the name to be printed also. The signature should be compared with the District account holder's name and registered owner's name (from KC Assessor's office).

6.5. All new/replaced side sewers should be flushed (with water) prior to CCTV post-installation inspection to document any belly situations.

6.6. Driveways should be documented in detail, especially those with multiple residents and/or are in marginal condition. The Contractor should be extra careful on these private drives.

6.7. Asphalt paving should be more definitively scheduled.

Project Cost Summary

Table 3 is a summary of project costs by project element. Appendix A includes a copy of the bid tabulation and final pay estimate. The District has budgeted a $100,000 reserve fund to address property drainage issues which may come up following construction. This reserve is not reflected in Table 3. Table 4 presents activity unit costs apportioned to the total construction cost.

Table 3: Project Cost Distribution

		District[1]	Engineer	Contractor[2]	Subtotal
Project Management					
	Quarterly Monitoring Reports		$ 5,348		$ 5,348
	Monthly Review		$ 2,481		$ 2,481
	Closeout Report		$ 12,154		$ 12,154
	King Co. Coordination	$ 4,000	$ 8,088		$ 12,088
	Project Management Subtotal	**$ 4,000**	**$ 28,071**	**$ -**	**$ 32,071**
Predesign					
	TV Reports – main line[3]	$ 2,400	$ 7,832		$ 10,232
	Records Research/Base Map	$ 800	$ 16,307		$ 17,107
	TV Side Sewers/Field Review[4]	$ 6,000	$ 45,097		$ 51,097
	Construction Method Review	$ 600	$ 8,404		$ 9,004
	Predesign Subtotal	**$ 9,800**	**$ 77,640**	**$ -**	**$ 87,440**
Public Relations					
	Public Meetings	$ 9,700	$ 24,571		$ 34,271
	Rights of Entry	$ 1,200	$ 8,823		$ 10,023
	Stormwater Mgmt	$ 300	$ 1,209		$ 1,509
	R/W Permit	$ 300	$ 1,086		$ 1,386
	Public Relations Subtotal	**$ 11,500**	**$ 35,689**	**$ -**	**$ 47,189**
Design					
	Plans	$ 800	$ 18,426		$ 19,226
	Specifications		$ 20,017		$ 20,017
	Estimate		$ 3,437		$ 3,437
	Design Subtotal	**$ 800**	**$ 41,879**	**$ -**	**$ 42,679**
Bidding/Contracting					
	Advertise/Open	$ 500	$ 5,212		$ 5,712
	Contract Documents		$ 3,903		$ 3,903
	Bid/Contract Subtotal	**$ 500**	**$ 9,115**	**$ -**	**$ 9,615**
Construction					
	Precon/Mobilization	$ 1,200	$ 8,273	$ 29,974	$ 39,447
	Side Sewer – Inspections		$ 36,315	$ 38,352	$ 74,667
	Side Sewer – Replacement	$ 4,000	$ 78,402	$ 942,553	$1,024,955
	Main Line Repairs		$ 5,349	$ 24,480	$ 29,829
	Manhole Repairs	$ 1,300	$ 973		$ 2,273
	Restoration/Record Drawings	$ 800	$ 21,030	$ 42,643	$ 64,473
	Construction Subtotal	**$ 7,300**	**$150,342**	**$ 1,078,002**	**$1,235,664**

		District[1]	Engineer	Contractor[2]	Total
	Total Project Cost[5,6]	**$ 33,900**	**$342,736**	**$ 1,078,002**	**$1,454,638**

Notes:
1. All District costs estimated by the Engineer.
2. Contractor's figures include applicable Washington State sales tax.
3. Does not include District's prior main line CCTV work or smoke testing.
4. Includes $32,000 for subcontracted CCTV side sewer/stub inspections from main line, for 160 stubs inspected.
5. King County's cost in support of this project are not accounted for above (website, SEPA, environmental review, first mailing, portion of side sewer CCTV work and project signs).
6. Includes actual costs through 8/31/04

The approximate cost for primary project activities is estimated as follows:

Table 4: Activity Unit Costs

Activity	Total	Quantity	Unit Cost
Pipeburst replacement of Side Sewers (per property)	$1,414,423	208	$6,800
"Inspection Only" of Side Sewer (per property)	4,661	20	230
Main Line CIP Spot Repair (per spot repair 3-feet± in length)	34,956	9	3,880

Summary

The goal of this pilot project was to determine the effectiveness of pipebursting all side sewers (regardless of condition). King County is still flow monitoring the region and will present its results (project cost vs. reduction in conveyance and treatment costs) later in 2004. However, other important lessons were learned along the way as discussed in the "Observations" and "Recommendations" above. Conclusions are as follows:

1. In this project, approximately 107 of the 160 (67%) side sewer stations were found to be defective.
2. Two-hundred-sixty-one (261) properties signed up for the project. The work completed is allocated as outlined in Table 5:

Table 5: Summary

Description of Completed Work	
Work on Private Property	
Side Sewer (only) by Pipebursting	151
Side Sewer and Stub by Pipebursting	57
Side Sewer and Stub by T-Liner®	0
Omitted[3]	9
"Inspect Only" Side Sewers	20
Omitted[4]	24
Total signed ROEs	261
Repairs of "Inspect Only" (included in "Side Sewer Only" total)	1
Work in Right-of-Way	
PVC Tee Replacement by Open-Cut[3]	2
Stub Replacement by Pipebursting	3
Stub Replacement by Open-Cut	2
Top Hat™ Repair	1
CIP Main Line Spot Repairs[5]	10

3. The pipebursting portion of the project was finished on schedule and under budget (86% of bid price) mainly due to BUNO's innovations:
    - Deleting T-Liner® repairs and completing such work with pipebursting, in spite of deeper stub connections
    - Pipebursting around bends (cost savings on number of cleanouts)
    - Pipebursting two (2) – 4-inch pipes in place of one (1) – 6-inch pipe

    However, the Contract end date was extended due to difficulties with scheduling T-Liner® and extended work schedule for paving restoration and completion of

[3] See 6.4.9
[4] See 6.4.2
[5] An additional CIP spot repair was made at 15214/20 Dayton and was included in the force account amount. Consequently, only nine (9) CIP spot repairs were paid while ten (10) were actually made.

administrative and contract closeout work. Ultimately, the work scheduled for T-Liner® repair was completed by pipebursting or open-cut pipe replacement.

4. Eleven (11) illegal connections were found, ten of which were disconnected.
5. The project was successfully implemented (scope, budget, schedule) due to the joint effort of the District, County, Engineer and Contractor. Having a contractor experienced with and successful in pipebursting was a critical factor. Determining the effectiveness of I/I removal by complete replacement of side sewers has yet to be made, pending review of flow monitoring data.
6. One significant unresolved issue is the difficulty in gaining voluntary participation by property owners that know or suspect they have an illegal connection, and don't want to bear the cost or burden of disconnection, even in conjunction with a project that will result in side sewer replacement at public cost for public benefit. The sewer service agency must decide how to enforce illegal connection prohibitions. This leads to enforcement questions such as:
    - Should there be a penalty for non-compliance? If so, what?
    - How much time should the property owner be given to comply?
    - Should enforcement be on a District-wide vs. project-specific basis?

    The District or County should consider exploring options to increase participation voluntarily, or consider legal means and ramifications for enforcement of existing policy prohibiting such connections. A statewide or at least regional solution is desired for consistency among local agencies.

APPENDIX
SUPPORTING DOCUMENTS

- FINAL PAY ESTIMATE
- BID-TAB

Project: Basin RON002 I/I Removal Pilot Project
Owner: Ronald Wastewater District
Contractor: BUNO Construction LLC
Period: January 1 to April 6, 2004

Bid Item No.	Bid Item Description	Unit	Bid Quantity	Unit Bid Price	Bid Amount	Quantity Complete To Date	TOTAL EARNED TO DATE
1.	Mobilization and Demobilization	LS	1	$27,500.00	$27,500.00	100%	$27,500.00
2.	Side Sewer Inspection	EA	247	$150.00	$37,050.00	235	$35,250.00
3.	Cleanout Installation (with s/s replacement)	EA	344	$50.00	$17,200.00	219	$10,950.00
4.	Cleanout Installation (with CIP Tee & Stub)	EA	4	$700.00	$2,800.00	1	$700.00
5.	Type A Side Sewer Replacement	EA	193	$2,400.00	$463,200.00	181	$434,400.00
6.	Type B Side Sewer Replacement	EA	30	$2,800.00	$84,000.00	31	$86,800.00
7.	Type C Side Sewer Replacement	EA	15	$3,100.00	$46,500.00	27	$83,700.00
8.	Type D Side Sewer Replacement	EA	4	$3,600.00	$14,400.00	26	$93,600.00
9.	Additional Side Sewer Connection	EA	100	$70.00	$7,000.00	78	$5,460.00
10.	Extra Excavation Depth (>4')	VF	210	$15.00	$3,150.00	153	$2,295.00
11.	Extra Excavation Depth (>8')	VF	150	$20.00	$3,000.00	328	$6,560.00
12.	Trenchless Main Line Spot Repair	EA	7	$2,500.00	$17,500.00	9	$22,500.00
13.	Trenchless CIP Tee and Stub Lining	EA	42	$3,400.00	$142,800.00	0	$0.00
14.	Additional CIP Stub Lining	LF	2,120	$33.00	$69,960.00	0	$0.00
15.	Downspout Drainage Diversion	EA	50	$100.00	$5,000.00	8	$800.00
16.	Record Drawing Sketches	EA	208	$50.00	$10,400.00	207	$10,350.00
17.	Asphalt Pavement Restoration	TN	200	$70.00	$14,000.00	228	$15,960.00
18.	Concrete Restoration	SY	1,000	$23.00	$23,000.00	123	$2,829.00
19.	Backfill Gravel	TN	2,700	$9.00	$24,300.00	1436.15	$12,925.35
20.	Asphalt Treated Base	TN	150	$70.00	$10,500.00	0	$0.00
21.	Crushed Rock Surfacing	TN	350	$11.00	$3,850.00	675.41	$7,429.51
22.	Controlled Density Fill	CY	200	$65.00	$13,000.00	0	$0.00
23.	Temp. Erosion & Sedimentation Control	LS	1	$5,500.00	$5,500.00	100%	$5,500.00
24.	Miscellaneous Work by Force Account	LS	1	$75,000.00	$75,000.00	40%	$30,286.57
25.	Shoring	LS	1	$34,000.00	$34,000.00	100%	$34,000.00
26.	Wage Rate Affidavits	EA	2	$25.00	$50.00	2	$50.00
CO1	Increase - Pipebursting in lieu of CIP Tee & Stub Lining (See Note Below)	LS	1	$62,340.00	$62,340.00	97%	$60,290.00
CO1*	Decrease - Deduction of CIP Tee & Stub Lining Work (See Note Below)	LS	1	($56,705.00)	($56,705.00)		
CO2	Reconcile Quantities	LS	1	($170,159.57)	($170,159.57)		
			Total Contract		$990,135.43		

TOTAL AMOUNT EARNED TO DATE	**$990,135.43**
Plus Sales Tax (8.8%)	$87,131.92
Minus Retainage, N/A - Retainage Bond	$0.00
Minus Payments Previously Made:	
Progress Payment #1 5/20/03:	$134,917.77
Progress Payment #2 6/20/03:	$230,343.41
Progress Payment #3 7/20/03:	$127,018.51
Progress Payment #4 8/20/03:	$210,078.68
Progress Payment #5 9/20/03:	$170,166.05
Progress Payment #6 10/20/03:	$58,857.53
Progress Payment #7:11/20/03:	$7,186.24
Progress Payment #8:12/31/03:	$96,788.48
TOTAL AMOUNT DUE THIS PAYMENT	**$41,910.68**
% Complete (as of % of Bid Amount Earned to Date)	**100.0%**

PAYMENT CERTIFICATE #9 (FINAL)
We hereby certify that, in accordance with the accompanying tabulation, the sum of $41910.68 is due and payable to the Contractor, BUNO Construction LLC This payment will cover the period January 1 to April 6, 2004 and is designated as the Progress Payment #9 (Final) and we further certify that 100% of the work has been completed and bond may be released upon:
1. The receipt of the release from the Sales Tax Commission.
2. Upon no liens filed against this Public Works Improvement within 45 days from April 6, 2004
3. The maximum amount of withholding time, or 60 days from April 6, 2004. (per RCW 60.28.011)

CHS Engineers, Inc.

*NOTE: Change Order No. 1 was for a net increase of $5,635.00 to the original contract. The increase was for work completed on certain properties in lieu of work as originally bid. The decrease represents the dollar amount for adjustment of quantities for work not paid nor completed under the original bid items on those same properties. The actual dollar amount of the decrease was determined by decreases in quantities of various bid items.

Project: Basin RON002 I/I Removal Pilot Project
Owner: Ronald Wastewater District
Contractor: BUNO Construction LLC
Period: January 1 to April 6, 2004

CONTRACT SUMMARY

Original Contract Sum	$1,154,660.00
Net Change by Change Order	($164,524.57)
Contract Sum to Date	$ 990,135.43
Total Completed to Date	$ 990,135.43
Total Retainage to Date	Bond
Less Previous Retainage	Bond
Retainage this Payment	Bond
Sales Tax to Date	$ 87,131.92
Less Previous Sales Tax	$ 83,742.08
Sales Tax this Payment	$ 3,389.84
Total Earned Plus Sales Tax	$ 1,077,267.35
Less Previous Payments	$ 1,035,356.67
CURRENT PAYMENT DUE	**$ 41,910.68**

See attached Exhibit A for Force Account Work

Ronald Wastewater District				Page 3 of 3
Basin RON002 I/I Removal Pilot Project				
Period - through 4/6/04				
Cost Adjustment by Force Account				
Address	**Sheet No.**	**Reason/Comment**	**Depth Compensation**	**Subtotal**
119 NW 156th	7	French Drain for downspout/yard drain		$ 450.00
115 NW 159th	8	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
118 NW 159th	8	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
15721 2nd Ave	8	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
15909 1st Ave	8	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
Highland Terrace School	11	Cleanout replacement and pipe inspection		$ 2,241.18
15528 Greenwood	12	Additional work to find/replace exist. side sewer		$ 3,040.77
15208 Dayton	4	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
15551 Greenwood	9	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
15724 Greenwood	13	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
15734 Greenwood	13	Deep dig-former CIP Tee & Stub Lining	$ 500.00	$ 500.00
15001 Dayton	3	Wrong Tee Location On Plan		$ 1,268.90
15031/39 Dayton	4	Wrong Tee Location On Plan (3 attempts)		$ 1,507.41
15539 Greenwood	9	Additional side sewer locate around north side of house		$ 817.80
15715 Greenwood	10	Wrong tee location		$ 2,089.94
15733 Greenwood	10	Reroute side sewer by open cut		$ 2,008.16
15019/25/29 Dayton	4	Wrong Tee Location On Plan (2 attempts)		$ 1,494.88
15236 Greenwood	6	Pipeburst at PVC s/s with Bad Gaskets		$ 6,170.00
15248 Dayton	5	Open cut/Pavement Rest/Backfall		$ 2,497.53
422 N 156th Ct	12	Repair Belly		$ 2,700.00
				$ 30,286.57

Called by: RONALD WASTEWATER DISTRICT For: BASIN RON002 I/I REMOVAL PILOT PROJECT Bid Opening: 10:30 a.m., THU MARCH 6, 2003			Bidders Name and Address	Engineer's Estimate		Buno Construction LLC 20219 99th Ave SE Snohomish, WA 98296		AVERAGE of UNIT PRICES (excluding high)	
Certified Tabulation of Bids Received		Total (w/o tax)			$ 1,470,610.00		$ 1,154,660.00		$ 1,407,755.00
By: _____			Bid Bond				5%		
Item No.	Description	Quantity	Unit	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
1	Mobilization and Demobilization	1	LS	$ 72,000.00	$ 72,000.00	$ 27,500.00	$ 27,500.00	$ 100,166.67	$ 100,166.67
2	Side Sewer Inspection	247	EA	$ 350.00	$ 86,450.00	$ 150.00	$ 37,050.00	$ 183.33	$ 45,283.33
3	Cleanout Installation (with s/s replacement)	344	EA	$ 400.00	$ 137,600.00	$ 50.00	$ 17,200.00	$ 241.67	$ 83,133.33
4	Cleanout Installation (with CIP Tee & Stub)	4	EA	$ 1,500.00	$ 6,000.00	$ 700.00	$ 2,800.00	$ 900.00	$ 3,600.00
5	Type A Side Sewer Replacement	193	EA	$ 1,900.00	$ 366,700.00	$ 2,400.00	$ 463,200.00	$ 2,366.67	$ 456,766.67
6	Type B Side Sewer Replacement	30	EA	$ 2,300.00	$ 69,000.00	$ 2,800.00	$ 84,000.00	$ 2,733.33	$ 82,000.00
7	Type C Side Sewer Replacement	15	EA	$ 4,200.00	$ 63,000.00	$ 3,100.00	$ 46,500.00	$ 3,766.67	$ 56,500.00
8	Type D Side Sewer Replacement	4	EA	$ 4,200.00	$ 16,800.00	$ 3,600.00	$ 14,400.00	$ 4,433.33	$ 17,733.33
9	Additional Side Sewer Connection	100	EA	$ 500.00	$ 50,000.00	$ 70.00	$ 7,000.00	$ 290.00	$ 29,000.00
10	Extra Excavation Depth (>4')	210	VF	$ 100.00	$ 21,000.00	$ 15.00	$ 3,150.00	$ 65.67	$ 13,790.00
11	Extra Excavation Depth (>8')	150	VF	$ 150.00	$ 22,500.00	$ 20.00	$ 3,000.00	$ 76.67	$ 11,500.00
12	Trenchless Main Line Spot Repair	7	EA	$ 2,500.00	$ 17,500.00	$ 2,500.00	$ 17,500.00	$ 1,933.33	$ 13,533.33
13	Trenchless CIP Tee and Stub Lining	42	EA	$ 3,750.00	$ 157,500.00	$ 3,400.00	$ 142,800.00	$ 2,833.33	$ 119,000.00
14	Additional CIP Stub Lining	2120	LF	$ 38.00	$ 80,560.00	$ 33.00	$ 69,960.00	$ 29.67	$ 62,893.33
15	Downspout Drainage Diversion	50	EA	$ 500.00	$ 25,000.00	$ 100.00	$ 5,000.00	$ 216.67	$ 10,833.33
16	Record Drawing Sketches	208	EA	$ 25.00	$ 5,200.00	$ 50.00	$ 10,400.00	$ 30.00	$ 6,240.00
17	Asphalt Pavement Restoration	200	TN	$ 140.00	$ 28,000.00	$ 70.00	$ 14,000.00	$ 82.67	$ 16,533.33
18	Concrete Restoration	1000	SY	$ 45.00	$ 45,000.00	$ 23.00	$ 23,000.00	$ 24.17	$ 24,166.67
19	Backfill Gravel	2700	TN	$ 15.00	$ 40,500.00	$ 9.00	$ 24,300.00	$ 9.67	$ 26,100.00
20	Asphalt Treated Base	150	TN	$ 65.00	$ 9,750.00	$ 70.00	$ 10,500.00	$ 73.67	$ 11,050.00
21	Crushed Rock Surfacing	350	TN	$ 30.00	$ 10,500.00	$ 11.00	$ 3,850.00	$ 21.00	$ 7,350.00
22	Controlled Density Fill	200	CY	$ 75.00	$ 15,000.00	$ 65.00	$ 13,000.00	$ 61.33	$ 12,266.67
23	Temp. Erosion & Sedimentation Control	1	LS	$ 10,000.00	$ 10,000.00	$ 5,500.00	$ 5,500.00	$ 6,833.33	$ 6,833.33
24	Miscellaneous Work by Force Account	1	LS	$ 75,000.00	$ 75,000.00	$ 75,000.00	$ 75,000.00	$ 75,000.00	$ 75,000.00
25	Shoring	1	LS	$ 40,000.00	$ 40,000.00	$ 34,000.00	$ 34,000.00	$ 32,066.67	$ 32,066.67
26	Wage Rate Affidavits	2	EA	$ 25.00	$ 50.00	$ 25.00	$ 50.00	$ 25.00	$ 50.00
	Subtotal				$ 1,470,610.00		$ 1,154,660.00		$ 1,323,390.00
	TAX calculated at 8.80%		TAX		$ 129,413.68		$ 101,610.08		$ 116,458.32
			TOTAL		**$1,600,023.68**		**$ 1,256,270.08**		**$ 1,439,848.32**
Comment Code							A		

LEGEND

A. Did not write contract total in words.

B. Did not write unit prices and contract total in words.

Called by: RONALD WASTEWATER DISTRICT For: BASIN RON002 I/I REMOVAL PILOT PROJECT Bid Opening: 10:30 a.m., THU MARCH 6, 2003			Bidders Name and Address	Mocon Corporation 13215-C8 SE Mill Plain Blvd #538 Vancouver, WA 98684		Callen Construction Co., Inc. PO Box 498 Custer, WA 98240		DDJ Construction Co., Inc 11301 186th Ave SE Issaquah, WA 98027	
Certified Tabulation of Bids Received By: _____		Total (w/o tax)			$ 1,187,980.00		$ 1,627,530.00		$ 2,110,433.00
			Bid Bond		5%		5%		5%
Item No.	Description	Quantity	Unit	Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
1	Mobilization and Demobilization	1	LS	$ 118,000.00	$ 118,000.00	$ 155,000.00	$ 155,000.00	$ 95,000.00	$ 95,000.00
2	Side Sewer Inspection	247	EA	$ 150.00	$ 37,050.00	$ 250.00	$ 61,750.00	$ 125.00	$ 30,875.00
3	Cleanout Installation (with s/s replacement)	344	EA	$ 200.00	$ 68,800.00	$ 475.00	$ 163,400.00	$ 157.00	$ 54,008.00
4	Cleanout Installation (with CIP Tee & Stub)	4	EA	$ 500.00	$ 2,000.00	$ 1,500.00	$ 6,000.00	$ 2,000.00	$ 8,000.00
5	Type A Side Sewer Replacement	193	EA	$ 1,400.00	$ 270,200.00	$ 3,300.00	$ 636,900.00	$ 5,400.00	$ 1,042,200.00
6	Type B Side Sewer Replacement	30	EA	$ 1,900.00	$ 57,000.00	$ 3,500.00	$ 105,000.00	$ 6,000.00	$ 180,000.00
7	Type C Side Sewer Replacement	15	EA	$ 2,200.00	$ 33,000.00	$ 6,000.00	$ 90,000.00	$ 6,500.00	$ 97,500.00
8	Type D Side Sewer Replacement	4	EA	$ 2,700.00	$ 10,800.00	$ 7,000.00	$ 28,000.00	$ 6,500.00	$ 26,000.00
9	Additional Side Sewer Connection	100	EA	$ 500.00	$ 50,000.00	$ 300.00	$ 30,000.00	$ 250.00	$ 25,000.00
10	Extra Excavation Depth (>4')	210	VF	$ 175.00	$ 36,750.00	$ 7.00	$ 1,470.00	$ 100.00	$ 21,000.00
11	Extra Excavation Depth (>8')	150	VF	$ 200.00	$ 30,000.00	$ 10.00	$ 1,500.00	$ 150.00	$ 22,500.00
12	Trenchless Main Line Spot Repair	7	EA	$ 2,100.00	$ 14,700.00	$ 1,200.00	$ 8,400.00	$ 2,500.00	$ 17,500.00
13	Trenchless CIP Tee and Stub Lining	42	EA	$ 3,300.00	$ 138,600.00	$ 1,800.00	$ 75,600.00	$ 3,850.00	$ 161,700.00
14	Additional CIP Stub Lining	2120	LF	$ 34.00	$ 72,080.00	$ 22.00	$ 46,640.00	$ 35.00	$ 74,200.00
15	Downspout Drainage Diversion	50	EA	$ 250.00	$ 12,500.00	$ 300.00	$ 15,000.00	$ 250.00	$ 12,500.00
16	Record Drawing Sketches	208	EA	$ 25.00	$ 5,200.00	$ 15.00	$ 3,120.00	$ 25.00	$ 5,200.00
17	Asphalt Pavement Restoration	200	TN	$ 96.00	$ 19,200.00	$ 82.00	$ 16,400.00	$ 85.00	$ 17,000.00
18	Concrete Restoration	1000	SY	$ 17.50	$ 17,500.00	$ 32.00	$ 32,000.00	$ 48.00	$ 48,000.00
19	Backfill Gravel	2700	TN	$ 9.00	$ 24,300.00	$ 11.00	$ 29,700.00	$ 16.00	$ 43,200.00
20	Asphalt Treated Base	150	TN	$ 77.00	$ 11,550.00	$ 74.00	$ 11,100.00	$ 75.00	$ 11,250.00
21	Crushed Rock Surfacing	350	TN	$ 22.00	$ 7,700.00	$ 30.00	$ 10,500.00	$ 75.00	$ 26,250.00
22	Controlled Density Fill	200	CY	$ 55.00	$ 11,000.00	$ 64.00	$ 12,800.00	$ 75.00	$ 15,000.00
23	Temp. Erosion & Sedimentation Control	1	LS	$ 5,000.00	$ 5,000.00	$ 10,000.00	$ 10,000.00	$ 500.00	$ 500.00
24	Miscellaneous Work by Force Account	1	LS	$ 75,000.00	$ 75,000.00	$ 75,000.00	$ 75,000.00	$ 75,000.00	$ 75,000.00
25	Shoring	1	LS	$ 60,000.00	$ 60,000.00	$ 2,200.00	$ 2,200.00	$ 1,000.00	$ 1,000.00
26	Wage Rate Affidavits	2	EA	$ 25.00	$ 50.00	$ 25.00	$ 50.00	$ 25.00	$ 50.00
Subtotal					$ 1,187,980.00		$ 1,627,530.00		$ 2,110,433.00
TAX calculated at		8.80%	TAX		$ 104,542.24		$ 143,222.64		$ 185,718.10
			TOTAL		**$ 1,292,522.24**		**$ 1,770,752.64**		**$ 2,296,151.10**
Comment Code					B				A

LEGEND

A. Did not write contract total in words.

B. Did not write unit prices and contract total in words.